Engineering UK 2018

Synopsis and recommendations

Engineering UK 2018: The state of engineering Synopsis

Engineering plays a vital role in the UK's economic and societal wellbeing, providing quality employment on a large scale and some of the key solutions to major global challenges. In the face of technological advancements and a changing political and economic landscape, developing the pipeline to address the skills needs of the engineering sector remains a key challenge.

The engineering footprint

Because the boundaries of what constitutes engineering are often blurred, determining a clear definition of engineering can be difficult, with different organisations historically taking different approaches. To aid consistency, in 2017 the Engineering Council, Royal Academy of Engineering and EngineeringUK reviewed and updated the list of jobs and industries deemed to constitute engineering. The footprint used in this report reflects this revised version.

The Engineering Council, Royal Academy of Engineering and EngineeringUK agreed to standardise the footprint using a binary approach, whereby an industry sector or an occupation is considered to be wholly in or out of the footprint. A set of criteria regarding the level of qualifications and skills deemed to be required for engineering roles was agreed and an extensive review of standard occupational classification (SOC) and standard industrial classification (SIC) lists undertaken.

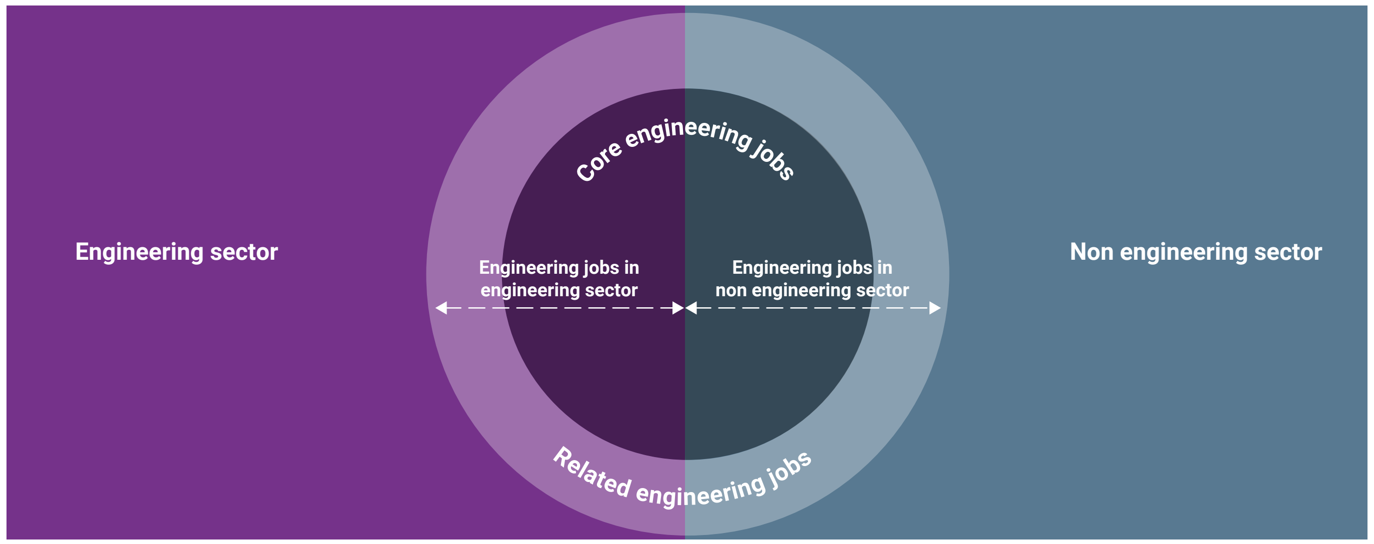
As a result of this review, 10 job titles were removed from the footprint, three were added and four remained with input from external organisations. Fourteen industries were removed from the list of SICs and two were added.

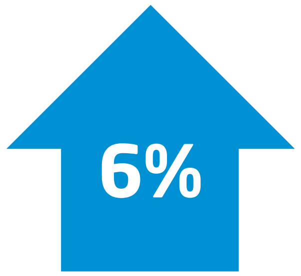
To further improve the precision of the engineering footprint, jobs within the footprint were furthermore classified as **core** or **related**.

Core engineering jobs were defined as engineering roles that require the consistent application of engineering knowledge and skills to execute them effectively. Core engineering jobs include those that are self-evidently engineering: the engineering professionals 'minor' group of civil, mechanical, electrical, electronics, design and development and production and process engineers. The 'core' definition also includes those who require consistent use of engineering competences – for example, a draughtsperson or a welder.

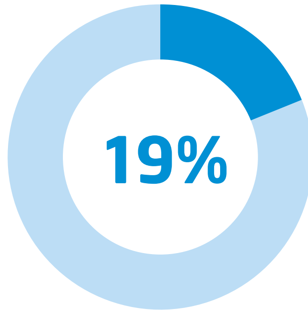
Meanwhile, **related engineering jobs** were defined as those that require a mixed application of engineering knowledge and skill alongside other skill sets, which are often of greater importance to executing the role effectively. An architect is an example of a related engineering occupation.

Revisions to the engineering footprint mean that figures concerning the engineering footprint in this report are not comparable to previous reports – but will enable consistency across the sector going forwards. Where time series are presented in the report, these figures have been recalculated to reflect the revised engineering footprint and are intended to be compared.





rise in number of UK engineering enterprises between 2015 to 2016



of UK total workforce employed in the engineering sector

Economy

Our findings unequivocally demonstrate engineering is a critical part of the UK economy, both in respect of direct contributions to turnover and employment and its 'multiplier' effect.

Productivity

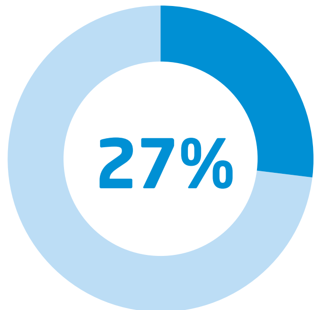
Productivity is a key factor in the standard of living in a national economy, with higher levels meaning improved economic growth and a more prosperous society, with attendant increases in funding for public services. That the UK has seen its productivity decline below that of competitor nations has been a long-standing concern for policy-makers and employers alike.

While the causes of the UK's poor productivity record are contested, it is clear that simply hiring more workers will not be enough to achieve a step change: the productivity of existing employees also needs to be improved, both through investment in technology and skills, and the strengthening of the educational pipeline.

Our findings show that engineering is a crucial sector for raising the UK's productivity levels. Research by the Centre for Economics and Business Research (Cebr) on EngineeringUK's behalf found that the engineering sector had a strong multiplier effect on the economy, generating a further £1.45 Gross Value Added (GVA) for every £1 GVA created directly in the engineering industries. What's more, every additional person employed through engineering activity was projected to create a further 1.74 jobs down the supply chain. Overall, they estimated that the engineering sector generated 25% of the UK's total GDP in 2015 (£420.5 billion).

Manufacturing enterprises within the engineering footprint remain the largest economic contributor of the engineering-based industries, generating £156.1 billion GVA (or 9.3% of the GVA for all industries) in 2015. Indeed, in 2016 almost half of the engineering footprint turnover came from manufacturing (46.5%). But contributions from other engineering sectors were also considerable: the construction industry generated GVA of £62.9 billion, IT, telecommunications and other information service activities £85.4 billion, and mining and quarrying £16.2 billion in 2015.

One of the more visible contributions of engineering to UK productivity is the construction of new national infrastructure. In July 2016, the government major projects portfolio had 143 projects worth over £455 billion. Skills found in the engineering footprint are needed for projects in every category in the portfolio.



of registered enterprises in the UK were in the engineering sector

1.74 jobs
supported by every person employed in engineering
(a multiplier effect of 2.74)

Engineering generated 23%
(£1.23 trillion) of the UK's total turnover

Engineering enterprises

Analysis by the Office of National Statistics for EngineeringUK indicates that just over a quarter (26.9% or 687,575) of the 2.55 million registered enterprises in the UK in 2016 were in the engineering sector, representing a 5.6% growth in terms of the number of enterprises over the previous year. Moreover, this year-on-year growth was observed across all industries within the engineering footprint. Reflecting the growing trend in digitalisation, the information and communication industry saw the largest increase in the number of engineering enterprises, growing by 7.6% over the last year and 40.8% over the last 5 year period.

Employment

Perhaps unsurprisingly, given its share of enterprise, the engineering sector employs a significant proportion of the overall UK workforce. In 2016, just under one in five (18.9% – or 5.66 million) people in the UK workforce were working in at an engineering enterprise. Those working in an engineering enterprise were most commonly employed in manufacturing (42.3%), followed by information and communication (19.5%) and construction (17.2%).

In respect of employment, it is clear some industries, such as information and communications, are expanding while others, notably mining and quarrying, are in decline. Also evident is the strong contribution EU nationals make to the engineering workforce. Data from the Labour Force Survery shows that 7.7% of workers in EngineeringUK sectoral footprint in 2016 were EU nationals, compared with 6.1% in non engineering sectors. And in the first quarter of 2017, EU nationals made up a higher share of the workforce in key engineering-related industries such as manufacturing (11.5%), construction (8.7%) and professional, scientific and technical activities (8.1%) than in the labour force overall (7.3%).

Turnover

The economic contribution of these engineering enterprises to the UK economy is significant. For the financial year March 2015 to March 2016, engineering enterprises registered for VAT and/or PAYE in the UK generated 23.2% (£1.23 trillion) of the UK's £5.3 trillion total turnover from all registered enterprises.

Skills needs

The world of work is changing, with a growing trend in economically developed countries toward an hourglass shaped economy. Technological advances have been key to this transformation, resulting in the expansion of knowledge-intensive services and increased demand for highly skilled labour. As we move further towards an hourglass economy, fuelled by the fourth industrial revolution, there are clear implications for the engineering sector and its skills needs.

In the two decades to 2014, the number of high-skilled jobs in the UK has risen by 2.3 million and, in some sectors, employers are routinely reporting that they are struggling to fill positions. 61% of businesses surveyed in the CBI/Pearson Education and Skills Survey expressed a lack of confidence that there will be enough people available in the future with the necessary skills to fill their high-skilled job vacancies. Shortages in highly skilled labour are expected to be exacerbated by the growth of new industries, some of which scarcely yet exist, emerging from new technologies and knowledge.

Emerging industries

In all engineering related industries, there is a trend towards increased automation and connectivity. Illustrative of this is the tremendous growth observed in information and communication, with turnover generated from the industry reaching £198 billion in 2016, a 23.5% increase from 2011 levels.

Meanwhile, the big data sector continues to grow. It is forecast to contribute £241 billion to UK GDP by 2020 and to create 157,000 new jobs. Going ahead, strong growth is also expected across the architecture and engineering job family, with 3D printing, resource-efficient sustainable production and robotics all seen as strong drivers.

157,000
new jobs in big data by 2020

7,200 engineering and technical workers needed in high speed rail by 2020

New technology is likewise transforming the engineering skills needs of construction and rail and road infrastructure. A critical part of Network Rail's railway upgrade plan, the largest modernisation programme since the Victorian era, involves moving from signalling based on fixed blocks of track to block signalling sited within moving trains to increase the capacity of the network. The programme includes High Speed 2 and Crossrail, as well as electrification and station upgrades. Unsurprisingly, these major projects necessitate a significant number of engineers. It is anticipated that an additional 7,200 engineering and technical workers will be needed in high speed rail by 2020.

This accelerating pace of technological, demographic and socio-economic changes is translating to changing needs in the labour. It is critical that the UK prepare itself for these changes. It is our actions today that will determine whether the wave of change brought by the fourth industrial revolution will result in a substantial displacement of workers or in the emergence of new opportunities.

Employment trends

Our analysis shows robust demand for labour, and an outstripping of supply in many engineering industries. April to June 2017 saw the highest vacancy ratio in the labour force since 2001, at 2.6 job vacancies for every 100 filled jobs. Yet this ratio was even higher in some engineering-related industries, including information and communication (3.3) and electricity, gas, steam and air conditioning supply (3.2). Large year-on-year percentage increases in the vacancy ratio were also observed in engineering industries such as mining and quarrying (up 66.7%) and construction (up 27.0%).

It is apparent that the scarcity of candidates, together with rising demand, has had a positive knock-on effect on engineers' salaries. Our analysis found that the median salaries of full time employees working in engineering occupations in 2016 – ranging between £32,987 for environment professionals and £47,394 for electronic engineers – compared very favourably to the overall average of £28,195.

However, while nominal wages are rising, real wages appear to be stagnant. Economists have speculated that this wage stagnation is both a consequence of the UK's low labour productivity and the inflation it has experienced since the country's decision to leave the EU.

Within this context, the UK's decision to leave the EU brings significant uncertainty to the sector. While the economy has not suffered as much as the Treasury predicted it would following the UK's decision to leave the EU, there are signs that this resilience is declining because of the falling pound and rising prices. There is also evidence to suggest the EU referendum result has reduced net migration numbers.

61% of businesses were not confident there will be enough people with the skills to fill their high-skilled job vacancies

124,000 engineers and technicians with core engineering skills required per year

79,000 engineering-related roles to arise per year

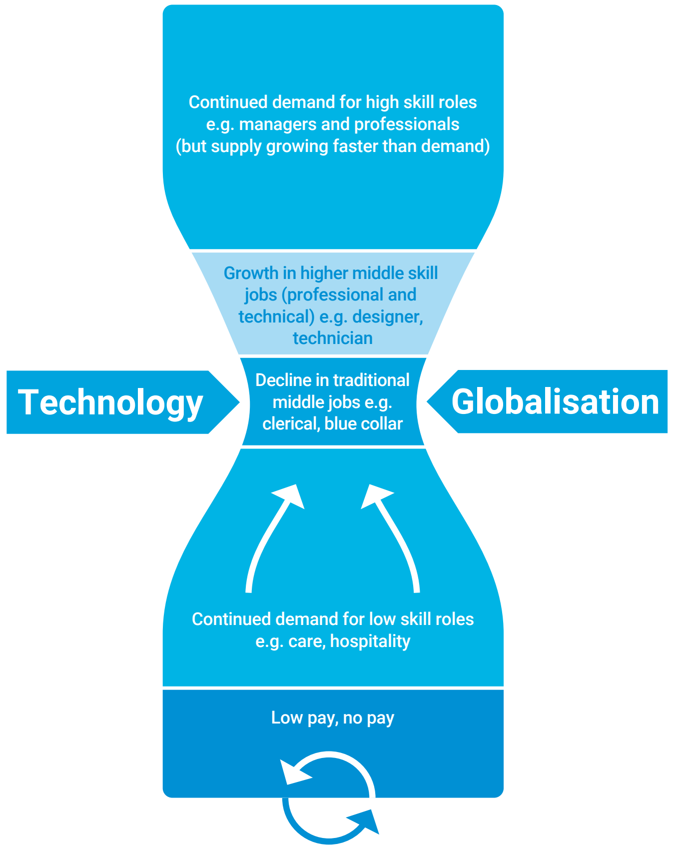
Demand forecasts

Across the UK and other developed nations, there is an increasing move towards an 'hourglass' economy, with rising demand for both high and low skilled labour. It is clear from our analysis that the engineering sector is no exception to this trend. Moreover, there is considerable demand for engineering skills outside of industries traditionally deemed to be engineering. Given the engineering talent currently coming out of the educational pipeline, we estimate there is an acute shortfall of engineering skills – and that this will continue without concerted action.

The hourglass economy

The increasing fusion between the digital, physical, and biological, has driven – and will continue to drive – already strong demand for highly skilled labour, especially in the area of STEM. Net requirement projections from Working Futures 2014-2024 indicate that by 2024, 54.1% of the workforce will require Level 4+ qualifications. This compares with 41.1% in 2014.

Going forward, it is also expected that demand for lower skilled jobs will increase. This is because while the semi-routine nature of many middle-skilled occupations are vulnerable to automation, traditionally low-skilled occupations often involve skills not readily automated. Such roles include those in health and social care, which are forecasted to increase alongside the needs of an ageing population. This 'hourglass economy' is expected to hold for the UK well into the future.



Altogether, **203,000** people with Level 3+ engineering skills will be needed every year to meet demand through to 2024

Annual shortfall of up to **59,000** engineering graduates and technicians to fill core engineering roles

Demand forecasts for engineering skills

A bespoke extension of *Working Futures* undertaken by Warwick Institute for Employment Studies on EngineeringUK's behalf estimates that between 2014 and 2024, 1,240,000 graduate and technician core engineering jobs will arise across all industries as a result of both replacement demand (i.e. the result of people leaving the labour force) and expansion demand (i.e. new jobs). Assuming that this is uniformly distributed across the ten years, this translates to a need to fill 124,000 Level 3+ core engineering roles every year.

Alongside this, we anticipate an additional annual requirement for 79,000 "related" roles requiring a mixed application of engineering knowledge and skill alongside other skill sets. Altogether, this means 203,000 people with Level 3+ engineering skills are required per year to meet expected demand.

Of this total annual net requirement, 57.7% is expected to arise in the engineering sector. That 42.3% of the projected requirement for Level 3+ engineering occupations is expected to arise outside of the engineering sector attests to the ubiquity of engineering skills required across industry.

Estimated shortfall

It is evident from our analysis that there is a critical shortfall in engineering skills across qualification levels and core and related engineering occupations.

Given the supply of engineering talent coming from the educational pipeline through apprenticeships and higher education, we estimate there to be a shortfall of between 37,000 to 59,000 in meeting an annual demand for 124,000 core engineering roles requiring Level 3+ skills. Within this, we expect a graduate-level shortfall of at least 22,000 per year.

Altogether – when looking at total demand for Level 3+ engineering skills across core and related engineering roles more broadly – we estimate the annual shortfall to be at least 83,000, and up to 110,000.

Labour force movement

It is accepted that the fulfilment of net recuitment requirements (whether from replacement or expansion demand) does not have to be met entirely from new entrants to the workforce from education. For example, some economically inactive people may transition back to the labour market. There is also movement within the labour force to and from engineering enterprises and occupations.

However, analysis into the extent to which there is occupational mobility to and from the engineering sector, undertaken by the Institute for Employment Studies on EngineeringUK's behalf, has concluded that these do not materially impact the engineering skills shortfall.

Using Labour Force Survey (LFS) data for the period 2006 to 2016, IES concluded that annual flows into and out of the engineering sector over the last decade were broadly net neutral. This has two implications. Firstly, our engineering skills shortfall estimates are robust against the omission of net intersectoral mobility. Secondly, while there is potential to reduce the shortfall by attracting more workers from other sectors and improving retention, so far annual net inflows into the engineering sector have been too small to make a tangible difference.

Changes and comparability

Both demand and shortfall figures presented in this report are not directly comparable to previous editions. This is due to the use of a revised engineering footprint, which has resulted in a narrowing of what is considered to be engineering, alongside refinement in the demand and supply methodology, such as the inclusion of forecasted demand arising in the non engineering sector. These changes aim to foster greater consistency in the sector going forward, and take into account the considerable need for engineering skills outside of industries traditionally deemed to be engineering.

Careers strategy
published in December 2017

New assessment system for GCSEs
in England phased in during summer 2017

Government strategies and policy initiatives

Population projections from the Office of National Statistics indicate that in the next 5 years, there will be considerable increases in the number of 12 to 16 year olds. Over the next 20 years, all age groups are expected to grow, especially those of secondary school age. This is encouraging for the potential engineering talent pool.

The extent to which this potential is harnessed will be dependent on the educational decisions young people make now and into the future. The government has introduced a number of strategies and policy initiatives, many of which are intended to address skills shortage and employability concerns. These are steps in the right direction, but it is essential that progress toward these stated objectives is carefully monitored over time.

Government strategies

The issue of the engineering skills gap continues to have a high profile across government, with significant investment and policy initiatives aimed at increasing the take up of STEM subjects, the status of technical education and the supply of key skills.

The industrial strategy, published in November 2017, emphasised the important role of education in driving skills, economic growth and productivity and the need to identify and address sector-specific skills gaps to support this objective.

The following month, the Department for Education published the long awaited careers strategy for England, which set out a plan to improve careers advice and guidance provision in England. This is a welcome initiative with a clear timetable for action, allowing the sector to hold the government to account for progress.

The government's vision for a revised technical education and apprenticeships landscape, its Social Mobility Action Plan and its commitments to raising the take up and quality of STEM learning through the industrial strategy is intended to bring about the 'skills revolution' this country needs, and safeguard investment in education and skills from the uncertainty surrounding Brexit.

Devolved administrations

In parallel to this, STEM education was the focus of a number of flagship initiatives across the devolved nations in 2017. Scotland saw the launch of a five year STEM Education and Training Strategy in October 2017. One of its key areas of intervention is the recruitment and retention of STEM teachers in schools, which has been a significant issue in recent years. Likewise, last summer the Welsh government announced a £3.2 million drive to improve how maths is taught in Welsh schools.

GCSE and A-level assessment

Summer 2017 saw the first GCSE maths and English results issued in England using a new assessment system with a 9 to 1 grading system, with the same change to sciences planned for summer 2018. At the same time the first awards of the new 'linear' A levels in biology, chemistry, computer science, and physics, where assessment is mainly by examination at the end of the course, were made.

Post-16 Skills Plan and apprenticeship reforms

Major changes to the technical education are underway. This has largely been driven by recognition of the skills shortage and perceived flaws within the current system, including the low qualifications value of many apprenticeships and a complexity that learners find difficult to navigate.

Some of the legal basis for these changes is provided by the Technical and Further Education Act, which received royal assent in 2017. The Act includes the so-called "Baker clause" (arising from an amendment proposed by former education secretary Lord Baker), which from January 2018 requires schools to give further education providers opportunities to inform pupils about the qualifications they offer, and publish a policy statement outlining how those providers can access their pupils.

Under the Post-16 Skills Plan, the government has proposed a common framework for 15 technical education routes for college-based and employment-based training. The intention is for there to be clearer delineation between academic and technical education, with learners working towards A-levels or T-levels, and apprentices able to transition between the two. An equalities impact assessment undertaken by the government suggests that there may be diversity issues arising from this approach, with those taking a technical route more likely to be male, of Caribbean ethnicity, have special

Apprenticeship levy introduced
in April 2017

Higher Education and Research Act
received royal assent in April 2017

educational needs and/or a disability, or eligible for free school meals. Ongoing monitoring of the policy and its consequences for young people is therefore important.

This plan seeks to build on existing apprenticeship reforms already underway in England, in the form of new apprenticeship standards, degree apprenticeships, and an apprenticeship levy on employers.

Since 2014, the Institute for Apprenticeships, which has responsibility for delivering high quality apprenticeship standards and assessment plans for England, has been working with groups of 'trailblazer' employers to develop new apprenticeship standards for different job roles. As of summer 2017, 160 new employer-led apprenticeship standards were ready for delivery, 83 in the engineering footprint.

In April 2017, the apprenticeship levy came into force, requiring companies with a wage bill exceeding £3 million to fund apprenticeships, in part to meet the government's target of 3 million apprenticeship starts in England by 2020. Though it is early days, some have expressed concerns that this could result in a compromise in quality. Further, fears of "relabelling" existing training to close back levy spend appear to be credible from evidence gathered by the CBI and Pearson.

Increasingly, the government has focused on apprenticeships at higher qualification levels, amid concerns that much of the initial growth in apprenticeship activity has been at low levels. It is already evident that degree apprenticeships – which combine aspects of both higher and vocational education – are attractive to HE institutions, with many investing considerable energy and resources into developing their provision. Many of the new degree apprenticeships on offer are engineering-focused, including in aerospace, automotive, construction, digital industries, electronic systems and nuclear, and lead to professional registration.

Higher Education and Research Act

There has been considerable change to the higher education landscape in recent years, with reductions in public funding across the UK and increasing undergraduate tuition fees in England.

2017 saw the passage of the Higher Education and Research Act (HERA), deepening the market approach already in place. Described by Wonkhe as "the most important legislation for the sector in 25 years", the Act aims to create more competition and choice, boost productivity in the economy, ensure students receive value for money and strengthen the UK's research and innovation sector.

To achieve this, HERA made way for a new regulator and funding council for universities called the Office for Students, which will hold the statutory responsibility for standards and quality. Notably, the Office for Students will oversee the Teaching Excellence Framework (TEF), an assessment of teaching quality, which includes the 'employability' of graduates as one of its assessment criteria. It is hoped TEF will contribute to addressing skills shortages, especially in high skilled STEM areas, where concerns have been expressed around some graduates not being sufficiently 'work ready'. However, concerns around the metrics used by TEF to measure employability have been raised in the sector.

The Act also brought the seven Research Councils, Innovate UK and the research functions of the Higher Education Funding Council for England (HEFCE) under a single body called UK Research and Innovation (UKRI) and created Research England, a new body that, among other things, may make provisions for universities to charge higher annual fees for 'accelerated degrees.'

10% **decrease in GCSE** entries for biology, chemistry and physics between 2012 and 2017

7% **increase in engineering-related** apprenticeship starts from previous year (England, 2015/16)

Trends in the educational pipeline

The largest flow of newly skilled talent into the engineering workforce comes directly from education. Between each educational stage, there is potential for 'leakage' from the pipeline, as individuals make voluntary decisions about their progression.

While trends in STEM education are broadly positive, developing the pipeline to address the skills shortage will continue to be a challenge for the engineering community. Gender representation, in particular, is a key concern.

Secondary school

GCSE entries are a major indicator of skills at the beginning of the engineering talent pipeline. Analysis of GCSE entries over the last five year period present a mixed picture, but often show declining entry numbers in STEM and, particularly for technology subjects, skewed towards entries by boys.

Entries for biology, chemistry and physics between 2012 and 2017 decreased by around 10%, for example, amid a backdrop of entries across all subjects increasing by 4.2% in the same period. Notably, entries for science, which as a subject previously had the second highest number of entries, have dropped by over 46% over the last five years. While in this time entries in additional science have increased (29.8%), it has done so at a lower rate than the decline observed in science.

At A-Level, entry numbers have encouragingly increased in mathematics, chemistry and physics over the last five years. However, that STEM subject pass rates remain significantly below average is a concern. With the exception of further mathematics (88.2%) and mathematics (80.3%), A* to C pass rates for all STEM subjects were below the all subject average of 77.4% in 2017. Furthermore, A* to C pass rates have declined in all STEM subjects (except computing) by at least 1 percentage point over the last 5 years, even as overall pass rates have increased by 0.8 percentage points.

Apprenticeships

Employer participation in apprenticeships has continued to increase. 262,500 employers in England employed apprentices in the academic year starting 2015, a 4.5% increase in the number who did so the previous year.

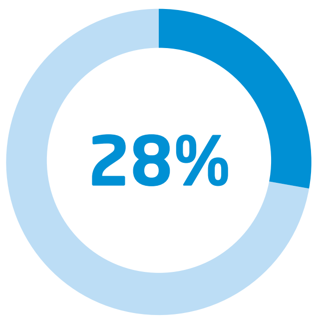
Encouragingly, engineering-related apprenticeships also appear to have grown in popularity. In England, the number of engineering-related apprenticeships starts in the academic year 2015 to 2016 increased by 7.4% over the year before, and in Scotland by 6.8%. The year-on-year increase was even higher in Wales, at 7.8%.

In total, 129,059 people started engineering-related apprenticeships across England, Scotland and Wales in 2015 to 2016, and 73,109 achieved success in the same year. Although apprenticeship figures are not disaggregated by start or achievement in Northern Ireland, the available data indicates 4,146 people were on engineering-related apprenticeships in 2016.

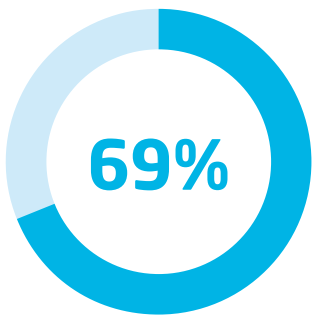
While these figures are promising, initial data from 2017 suggest apprenticeship starts are dropping. This decline has coincided with the introduction of the apprenticeship levy.

It is furthermore clear that more needs to be done to raise awareness and understanding of apprenticeships among young people. In the Engineering Brand Monitor 2017, 58% of 11

First degree



Taught postgraduate



28% of students in engineering-related first degree courses and 69% students in postgraduate taught courses were not from the UK

Proportion female

50% GCSE physics entrants

22% A level physics entrants

16% Engineering and technology first degree entrants

8% Engineering apprenticeship starts (England only)

to 14 year olds surveyed indicated they knew almost nothing or just a little about what apprentices do and the different types of apprenticeships available. Understanding was similarly low among parents surveyed, with only 46% indicating knowledge of what apprentices do and 55% about the different types of apprenticeships available.

Further education

The national colleges and the institutes of technology are the latest of a number of vocationally related institute types and policy initiatives introduced by government in an effort to increase the quality and provision of higher-level technical education across the country. Both are so new that it is too early to make any judgements as to their impact on the FE landscape and supply of skilled people to their respective industry sectors.

As part of the response to the Sainsbury Review, the government announced it would invest nearly £80 million in May 2016 to create employer-led national colleges in 5 areas. The National Colleges for High Speed Rail (with hubs in Birmingham and Doncaster) and for Nuclear (with hubs in Somerset and Cumbria) started their first courses in late 2017. The National College for Onshore Oil and Gas was intended to open at the same time but has been delayed. Institutes of technology, which may be based at existing further education colleges, are expected to open in 2018.

Higher education

There are widespread concerns that the UK's decision to leave the EU will make the higher education (HE) sector less attractive to international staff and students, and make it harder to access research funding and collaboration opportunities. Together, these could negatively affect the quality of UK HE teaching and research, particularly in engineering, which has a high proportion of international students. This is most apparent at taught and research postgraduate levels, where international students make up 68.9% and 61.1% of engineering and technology students respectively; within some engineering disciplines, this proportion exceeds 80%. It is possible that the continuation of these courses – and the supply of engineering and technology skills at level 4+ – may be affected by changes to the mobility of international students.

The final Brexit agreement with the EU is uncertain, but for universities there is a very real possibility they will be less able to recruit EU students and attract EU research funding beyond 2020. This would reduce income at a time when many face multiple pressures, especially in high-cost subjects. The debate on immigration and the rhetoric around Brexit may also impact on the views of those international students and researchers considering the UK. In light of these changes, institutions will need to work hard to ensure that the UK remains a destination of choice for students and staff alike.

In terms of trends, total student numbers have decreased over the last five years for which data is available, with the biggest fall in the year tuition fee arrangements in England changed. However, in the academic year 2015 to 2016, there was a small year-on-year increase in HE student enrolments for the first time since 2010 to 2011.

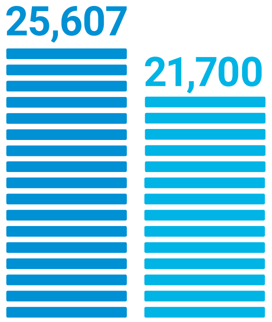
There was a 1% increase in the number of HE students studying engineering and technology in 2015 to 2016 compared with the previous year, taking the total to 163,255. This was due largely to a rise in entrants at first degree level. It is the third consecutive year in which numbers have increased, whereas overall HE student numbers have fallen in two of those years.

However, in the academic year 2015 to 2016, fewer students started both taught and research postgraduate engineering and technology courses, falling 3.5% and 9.2% on the previous year to 16,570 (taught) and 4,460 (research).

Women comprised just 16% of first degree in engineering and technology students in 2015 to 2016, compared with 50.1% of STEM first degree entrants and 56.1% of first degree entrants overall. They were better represented at postgraduate level, making up a quarter of both taught and research students. This suggests they are more likely to pursue postgraduate study than their male peers. Nevertheless, the fact remains that women are severely underrepresented in engineering and technology across all levels of HE, including at postgraduate levels.

62%

of engineering and technology graduates entered full time employment, compared with 56% of all graduates



The mean starting salary for engineering and technology graduates was 18% higher than for graduates overall

Transition to employment

Employment prospects for engineering and technology students are strong, with graduates having better chances of both getting a full-time job and earning higher starting salaries than other graduates. However, it is evident that there are ethnic and gender disparities in graduate outcomes with respect to destination and pay. Furthermore, work readiness of graduates remains a concern among employers.

Graduates’ employment prospects

In terms of finding full time employment, UK domiciled first degree graduates who had studied engineering and technology full time fare better than average. In 2015 to 2016, 62.0% entered full time employment, compared with 56.1% of all graduates, with fewer than the all subject average entering part time work (8.0%) or work and further study (2.8%). Employment outcomes for full time UK domiciled engineering and technology postgraduates are better still: 63.5% of taught postgraduates and 80.7% of research postgraduates entered full time employment in 2015 to 2016.

It is also evident that engineering and technology graduates have strong earnings potential. With a mean starting salary of £25,607, engineering and technology first degree graduates earned 18.0% more than the average for a graduate in the six months after leaving university. Only graduates in medicine and dentistry and veterinary science earned higher starting salaries. Likewise, mean salaries for employed engineering and technology postgraduate taught graduates (£27,623) were 10.5% higher than the overall average for UK full-time domiciled taught postgraduates (£25,002). The same was true of UK full-time doctoral level graduates, who earned 3.1% more than the all subject average of £33,092.

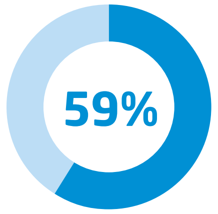
Communicating the financial opportunities an engineering and technology degree affords is key to improving the engineering talent pipeline. As findings from our Engineering Brand Monitor show, while more than three in five young people aged 11-19 thought that engineers were ‘well paid,’ only 20% were able to accurately guess the broad salary range for the average graduate engineer, with nearly three in five indicating a salary band considerably lower. This is significant, as we found that among respondents, pay was one of the most important factors when deciding upon a career – second only to it being something they were interested in.

There is, however, a clear distinction between employment and employability. Both the Wakeham and Shadbolt reviews presented evidence of employers being dissatisfied with the level of graduates’ ‘soft’ skills or ‘work readiness’. Myriad research into employer requirements support these assertions and indicate graduates would benefit from greater opportunities in the curriculum to develop business skills and gain real world work experience.

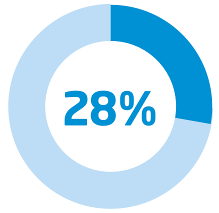
Furthermore, there are marked differences in destinations between white and BME leavers. Our analysis found that a much larger proportion of white engineering and technology graduates entered full time employment (65.6%) within six months of graduating in the academic year 2015 to 2016 than those of ethnic minority background (48.6%). Although this trend can be observed among UK domiciled leavers of different ethnicities who studied full time in general, these differences were more pronounced among engineering and technology graduates.

There are likewise differences in outcomes by gender. While full time employment rates are similar among male and female engineering and technology graduates, larger proportions of men enter engineering occupations than women. Among engineering and technology graduates who found employment six months after graduation, 35.7% of women were in roles that were neither engineering-related or within the sector. This compares to 29.6% of male engineering and technology graduates.

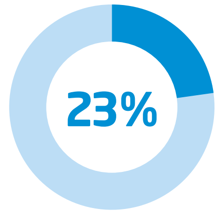
These figures are concerning, at the very least indicating female and BME graduates are ‘leaking’ from the pipeline. Further investigation is needed to look at whether these gender and ethnicity gaps come from engineering graduates’ own choice of career direction or are down to factors in the occupational recruitment process.



of 11 to 14 year olds surveyed would consider engineering, compared with 39% of 16 to 19 year olds



of 11 to 14 year olds surveyed have taken part in a STEM careers activity in the last year



of teachers who qualified in England between 2011 and 2015 had left the profession by 2016

Harnessing the talent pool

As our EBM findings – and, more broadly, this report – highlight, if we are to address the severe skills shortage in engineering, we must effectively harness the talent pool of young people. To be successful, this endeavour must be extensive and inclusive: working across the education, government, and industry sectors; engaging with young people, teachers, and parents; and employing a variety of activities to engage young people of all backgrounds. While ultimately it is up to the young person to decide whether they want to pursue engineering, there is much work we can do as a community to ensure young people are well informed when making their educational and career decisions.

Perceptions and attitudes toward engineering

There are signs that young people’s interest in the engineering profession is growing. According to EngineeringUK’s Engineering Brand Monitor Survey (EBM), the proportion of young people aged 11 to 19 who would consider a career in engineering has risen from 40% in 2013 to 51% in 2017.

However, the older pupils get, the less likely they are to consider a career in engineering: 39% of 16 to 19 year olds in 2017 would consider engineering, compared with 59% of 11 to 14 year olds. While this may partly be due to older pupils having clearer career aspirations and solidifying their plans, it also confirms that sustaining young people’s interest as they progress through secondary education is a key challenge.

Evidence also suggests that there is more work to be done in informing young people, especially girls, about what a career in engineering can entail. Our EBM results indicate that at every age, boys are far more likely to consider a career in engineering than girls. The findings further suggest that pupils across all ages are less likely to understand engineering careers than science or technology careers. Evidence from the ASPIRES project supports this, indicating that young people often have poorly formulated views of what engineering jobs actually entail.

There is also more to do to improve the image of the profession so that more young people see it as desirable. Adults and teachers surveyed in the EBM were more likely to view a career in engineering as desirable for their children or for young people than young people themselves: nearly 7 in 10 adults and 8 in 10 teachers said so, compared with 44% of pupils (16 to 19 year olds).

Teacher shortages

Though STEM teacher recruitment and retention has been a longstanding problem, it has become acute in recent years. Pupil numbers have grown by nearly half a million between 2011 and 2016, but the number of STEM specialist teachers has remained largely stagnant since 2015.

2017 marked the fifth consecutive year in England for which recruitment targets for trainee teachers were missed, with the shortfall particularly pronounced in STEM subjects. In the year 2017 to 2018, there was an estimated shortfall of 2,188 STEM trainee teachers against the DfE teacher supply model target. Only 33.4% of design and technology places were filled in England in that academic year, as were 68.1% of physics and 78.9% of maths positions.

Teacher retention has also not seen improvement. Of the 117,000 teachers who qualified in England between 2011 and 2015, 23% had left the profession during that time. Moreover, the proportion of those leaving for reasons other than retirement has grown from 68% in 2011 to 75% in 2014. In particular, retention of newly qualified science teachers is a concern, with recent research suggesting that they are 20% more likely to leave the profession within their first five years than similar newly qualified non-science teachers.

These shortfalls persist despite many attempts by governments across the UK to address these issues. It is therefore crucial that the government, engineering industry, and education sector work together on innovative approaches to incentivise talent into the STEM teaching profession, and to improve retention.

Current careers provision

Access to engineering careers requires a well-functioning system of careers education and guidance. However, careers provision in England remains inconsistent and can miss those who need it most.

In a national survey of over 13,000 year 11 students (aged 15 to 16 years) in England, less than two-thirds indicated that they had received careers-related education. The study also found careers provision to be “patterned by social injustices”, with girls, minority ethnic, working class and lower-attaining students less likely to receive careers education than their peers. Encouragingly, our EBM results suggest that the proportion of 11 to 14 year olds who have taken part in a STEM careers activity is rising, standing at 28% in 2017 compared with 23% in 2016.

Female
47% of UK workforce
12% of engineers and technicians

BME
12% of UK workforce
8% of engineers and technicians

There is evidence that schools often struggle to differentiate between the offers in a very crowded market and to identify the activities that would be most appropriate and impactful in their setting. In fact, the Royal Academy of Engineering (RAEng) estimates more than 600 UK organisations run STEM engagement initiatives directed at schools. Given the amount of effort and resources directed to delivering STEM inspiration and enrichment initiatives, there is an urgent need to identify which are most impactful so that resources are appropriately targeted and evidence-based. In this respect, the Department for Education's recently published careers strategy is a welcome move.

Diversity

Tackling diversity issues at every stage of the educational pipeline and in the profession needs to be a key priority for the engineering community. Employers in the engineering sector have a very significant role to play in promoting equality and diversity, working with schools, universities and on their own.

It is evident the engineering workforce does not reflect the diversity of the overall working population, particularly in respect of gender. While women comprised 46.9% of the overall UK workforce in 2016, they only made up 20.5% of those working in engineering sector. This proportion is even lower when considering just those working in core and related engineering roles, at 12.0%. Likewise, only 8.1% of workers in the engineering sector were from ethnic minority groups, compared with 12.7% in non-engineering sectors, and 12.2% of the broader population.

Our report finds strong evidence that girls and people from BME communities are being lost at different points within the educational pipeline. It is clear that these 'leakages' ultimately contribute to the underrepresentation of these groups in the engineering profession.

For example, at secondary school level, only 27.1% of girls' A level entries in 2017 were in STEM subjects, compared with 45.6% of boys' entries. Gender underrepresentation is particularly pronounced within A-level computing and physics, where girls comprised just 9.8% and 21.5% of entries, respectively, in 2017.

Diversity also remains a concern in technical education. Just 7.5% of engineering related apprenticeship achievements in England and 3.4% in Scotland were completed by women in 2015 to 2016. And while 10.3% of people achieving apprenticeships in England overall were from BME backgrounds – the highest ever recorded, the proportion lagged behind in engineering-related sector subjects, at 6.8%.

Nevertheless, there are signs that female representation is slightly improving in engineering degree courses. For example, the proportion of women entering first degree undergraduate engineering and technology subjects increased from 15.1% in the academic year starting in 2014 to 16.0% the following year. However, out of all subject areas, engineering and technology had the second lowest proportion of first degree entrants who were women in the academic year starting in 2015 – only computer science had a lower proportion, at 14.9%. This contrasts with the number of women starting STEM first degrees (50.1%) and first degrees overall (56.1%).

Furthermore, although students from a BME background are well represented within higher education (where they represent 25% of engineering students), there are clear degree attainment gaps, with outcomes for BME first degree engineering and technology qualifiers consistently lower on average than white qualifiers. Four in five (80.4%) of white students obtained a 'good' (first or upper second class) degree in engineering and technology in the academic year starting 2015, compared with 68.5% of BME qualifiers.

There are also equality issues apparent in labour market outcomes, with lower rates of female and BME engineering and technology graduates going on to engineering-related roles or working within the engineering sector than their male and white peers. Likewise, gender pay gaps are evident among those working in engineering occupations, with the average full time salary higher for women than for men in only two SOC core engineering occupational groups (electrical engineers and electrical and electronic trades not elsewhere classified). However, our analysis suggests that although there is a gender pay gap in engineering, it is generally smaller than observed more widely in the labour force.

While discussion on social mobility in this report is limited, the growing focus on social mobility in the wider policy environment is good news for STEM skills shortages, as this may translate into the talents of more young people being recognised and used. Growth in demand for STEM skills likewise represents a significant opportunity to promote greater overall social mobility in the UK.

Challenges and recommendations

If modern engineering is to continue to provide its enormous economic and social contributions to the United Kingdom, it is of critical importance that the engineering community work alongside the government and educational sector to address the skills shortage.

Challenges

In the context of strong demand for engineering skills and a changing political and economic landscape, it is essential that we encourage young people to study STEM subjects and pursue engineering-related qualifications. Our report highlights that while there has been positive movement, there continue to be significant challenges to addressing the skills shortage in engineering:

- **Too few STEM teachers.** Recruitment and retention of STEM specialist teachers, who have a vital role in shaping the aspirations and career trajectories of young people, remains a key issue.
- **Limited access to STEM careers activity.** Access to inspirational engineering-focused engagement activities, which can help to ensure young people experience real life applications of engineering and make well-informed subject and career decisions, is uneven.
- **Too many initiatives.** Schools often struggle to identify which STEM engagement initiatives are most appropriate and impactful for their setting.
- **Too few women becoming engineers.** Women are underrepresented in every stage of the educational pipeline into engineering and among those working in the profession.
- **Too little home grown talent.** Our current reliance on international students leaves the engineering talent pipeline vulnerable to changes that could occur once the UK leaves the EU.
- **Too little understanding of apprenticeships.** There is a need to increase awareness and improve perceptions of apprenticeships as a worthy alternative to a university education – and to ensure the apprenticeships on offer are of high quality.

Recommendations

There are a number of specific actions that we recommend taking to tackle these challenges. Notably, these require the involvement of not only the engineering and STEM outreach communities, but also the education sector and the government. Closer collaboration between these four groups is key if we are to ensure young people experience real life applications of engineering, are well-informed of the many opportunities a career in the profession can provide – and ultimately, the shortage in engineering skills is addressed.

1. Streamline the STEM outreach landscape. The engineering and STEM outreach communities need to make it simpler for schools to connect with employers and other providers to access high quality, engineering focused STEM engagement activity. The re-positioning of the Tomorrow's Engineers programme as the go to place for such activity will address this and we encourage the whole community to get behind this work.

2. Understand what works. The engineering and STEM outreach communities should develop a better understanding of what engineering-focused careers interventions work. Strengthening evaluation of existing programmes and sharing good practice can help to ensure we direct our resources most effectively.

3. Address the STEM teacher shortage. The government should work with the engineering and education communities to increase the supply and retention of specialist STEM teachers. This has been a long-standing issue, and one that requires innovative approaches to address.

4. Safeguard against the potential negative implications of Brexit. The government must ensure the UK's exit from the European Union does not exacerbate the engineering skills shortage. In particular, it is vital that the higher education sector maintain its status as world-class and welcoming to talent across the world.

5. Ensure apprenticeships are of high quality. Engineering employers and the government need to increase the supply of high quality apprenticeships. Further work is required to raise awareness of apprenticeships among young people and their influencers. In addition, we recommend that the apprenticeship levy be reviewed to ensure it is having its intended effect.

6. Raise understanding and awareness of engineering. The engineering community should ensure young people have a full understanding of the excitement and variety a career in engineering offers, and the potential contribution they can make as an engineer. The Year of Engineering and This is Engineering campaigns are key opportunities to showcase the profession to a new generation, and ones that need to be embraced and supported by the community.

7. Improve diversity and inclusion. The engineering community should improve its diversity and inclusion record. We need to better understand the barriers for women, black and minority ethnic communities and people from disadvantaged backgrounds to pursue pathways into, and careers in, engineering.

EngineeringUK